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Effects of body weight loss (BWL) and rehydration (REHYD) on marksmanship after exercising in the heat (91°F, 20.4% humidity) in MOPP IV were assessed. Sixteen male soldiers walked (2.5 MPH) for six 50/10 minute work/rest cycles. Water intake was ad lib. Subjects were tested on the Weaponeer M16A1 rifle simulator in NO MOPP and MOPP IV pre and postexercise. Subjects fired two 9-round shot groups at a simulated 25-meter zeroing target in each condition. Shot groups were digitized to obtain 4 marksmanship measures: average distance from center of mass (DCM), tightness of shot group (TSG), horizontal TSG and vertical TSG. Two post hoc groups were formed for %BWL/hr and % REHYD using the median as the cutoff point. Postexercise, DCM was significantly greater in the low %REHYD group compared to the high %REHYD group ($p<.03$). Similarly, postexercise the high %BWL/hr group DCM was significantly greater than the low group ($p<.04$). A significant ($p<.01$) clothing (MOPP IV vs. NO MOPP) by administration (pre vs. postexercise) interaction for DCM was found. The results demonstrate that exercising in the heat in
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19. ABSTRACT (continued)

MOPP IV significantly impairs marksmanship. Individuals with a high %BWL/hr as well as those who do not rehydrate adequately are significantly degraded in marksmanship.

Fluid Loss and Body Rehydration Effects on Marksmanship

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Abstract

Effects of body weight loss (BWL) and rehydration (REHYD) on marksmanship after exercising in the heat (91°F, 20.4% humidity) in MOPP IV were assessed. Sixteen male soldiers walked (2.5 MPH) for six 50/10 minute work/rest cycles. Water intake was ad lib. Subjects were tested on the Weaponeer M16A1 rifle simulator in NO MOPP and MOPP IV pre and postexercise. Subjects fired two 9-round shot groups at a simulated 25-meter zeroing target in each condition. Shot groups were digitized to obtain 4 marksmanship measures: average distance from center of mass (DCM), shot group/ overall tightness (SG/OT), SG/horizontal tightness (SG/HT), and SG/vertical tightness (SG/VT). Two post hoc groups were formed for %BWL/hr and %REHYD using the median as the cutoff point. Postexercise, DCM was significantly greater in the low %REHYD group compared to the high %REHYD group ($p<.03$). Similarly, postexercise the high %BWL/hr group DCM was significantly greater than the low group ($p<.04$). A significant ($p<.01$) clothing (MOPP IV vs. NO MOPP) by administration (pre vs. postexercise) interaction for DCM was found. The results demonstrate that exercising in the heat in MOPP IV significantly impairs marksmanship. Individuals with a high %BWL/hr as well as those who do not rehydrate adequately are significantly degraded in marksmanship.

Research on soldiers performing in the Mission Oriented Protective Posture (MOPP) has shown detrimental effects in psychological and performance variables especially when exercising in the heat (2,8). The detrimental effect of heat on M16 marksmanship ability while performing in MOPP IV has been reported previously while using the Weaponeer, an M16A1 rifle simulator, (5,7). Previous research (1,3,9) has shown the negative effects on exercise performance and incidence of heat casualties associated with dehydration. However, to date there are no known studies documenting the level of marksmanship degradation associated with voluntary dehydration.

The purpose of this study was twofold. First, to assess marksmanship performance changes due to the effects of wearing the chemical protective ensemble while exercising in the heat. Secondly, to assess the effects of fluid loss as well as rehydration on simulated M16 marksmanship performance.

Methods

Sixteen male military personnel volunteered to participate in the study. All subjects were asked to read and sign a volunteer agreement of informed consent. Subjects practiced on the Weaponeer to familiarize themselves with the simulator. Subjects were then tested in NO MOPP (T-shirt, shorts, socks, and sneakers) and in the MOPP IV configuration. Subjects fired three practice shots and then two 9-round shot groups at a simulated 25-meter zeroing target in each condition. Subjects then exercised in an environmental chamber (91°F, 20.4% humidity) in MOPP IV walking on a treadmill (2.5 MPH) for six 50/10 minute work/rest cycles. Termination of the exercise occurred at the end of six hours or upon medical or voluntary withdrawal. Water intake was ad lib. Nude body weights were recorded before and after the test. All water intake volumes were recorded as well as urine excreted volumes. Post exercise, subjects again fired three practice shots and then two 9-round shot groups at a simulated 25-meter zeroing target, first in MOPP IV (i.e. MOPP was not broken after the exercise session) and then in the NO MOPP condition after doffing the MOPP ensemble.

The printouts of the shot groups were digitized to obtain four marksmanship measures; 1) average distance from center of mass (DCM), 2) shot group/overall tightness (SG/OT), 3) shot group/horizontal tightness (SG/HT), and 4) shot group/vertical tightness (SG/VT). The measures were obtained by digitizing the shots as well as the center of mass on the Weaponeer paper printout records of all trials via an Altek digitizing table and AC40 controller (Silver Spring, MD). All measures refer to actual distance in millimeters obtained from the target as represented on the standard paper printout. SG/OT is the average distance of all shots away from the mean shot location obtained by using the standard deviation of DCM.

Results

A significant clothing X administration interaction ($p<.01$) via a repeated measures analysis of variance was found on DCM (see Figure 1). Post hoc analysis via t-tests revealed no difference in the preexercise condition between NO MOPP and MOPP IV and no difference for either clothing condition from pre to postexercise. However, a significant difference did exist between the NO MOPP and MOPP IV conditions postexercise ($p<.02$) with MOPP IV being significantly greater. A main effect of administration on SG/OT indicated a significantly greater shot group dispersion ($p<.01$) postexercise (pre $x=2.58$ mm, post $x=3.36$ mm). Both the vertical and horizontal components of SG/OT were also significantly greater postexercise ($p<.01$ and $p<.03$, respectively) (SG/HT: pre $x=6.45$ mm, post $x=7.74$ mm; SG/VT pre $x=6.25$ mm, post $x=8.07$ mm).

Marksmanship performance was also examined as a function of body weight loss (BWL) and rehydration (REHYD) status. Two post hoc groups were formed for %BWL/hr and %REHYD using the median for each variable as the delineation point. The median %BWL/hr was .254% of the total body weight and %REHYD was 68.16%. Postexercise, DCM was significantly greater in the low %REHYD ($x=10.84$) group compared to the high %REHYD ($x=5.65$ mm) group ($p<.03$) in MOPP IV. Similarly, postexercise, those individuals in the high %BWL/hr ($x=10.74$ mm) group shot significantly farther away from center of mass than the low %BWL/hr group ($x=5.74$ mm) ($p<.04$) while clad in MOPP IV.

Discussion

From Figure 1 it may be seen that there was a slight improvement in the NO MOPP (8.62%) condition combined with the slight degradation in MOPP IV (8.87%) accounting for the interaction finding. The improvement may have been due to learning effects while degradation is probably due to the fatiguing effects of exercising in the heat in MOPP IV and dehydration.

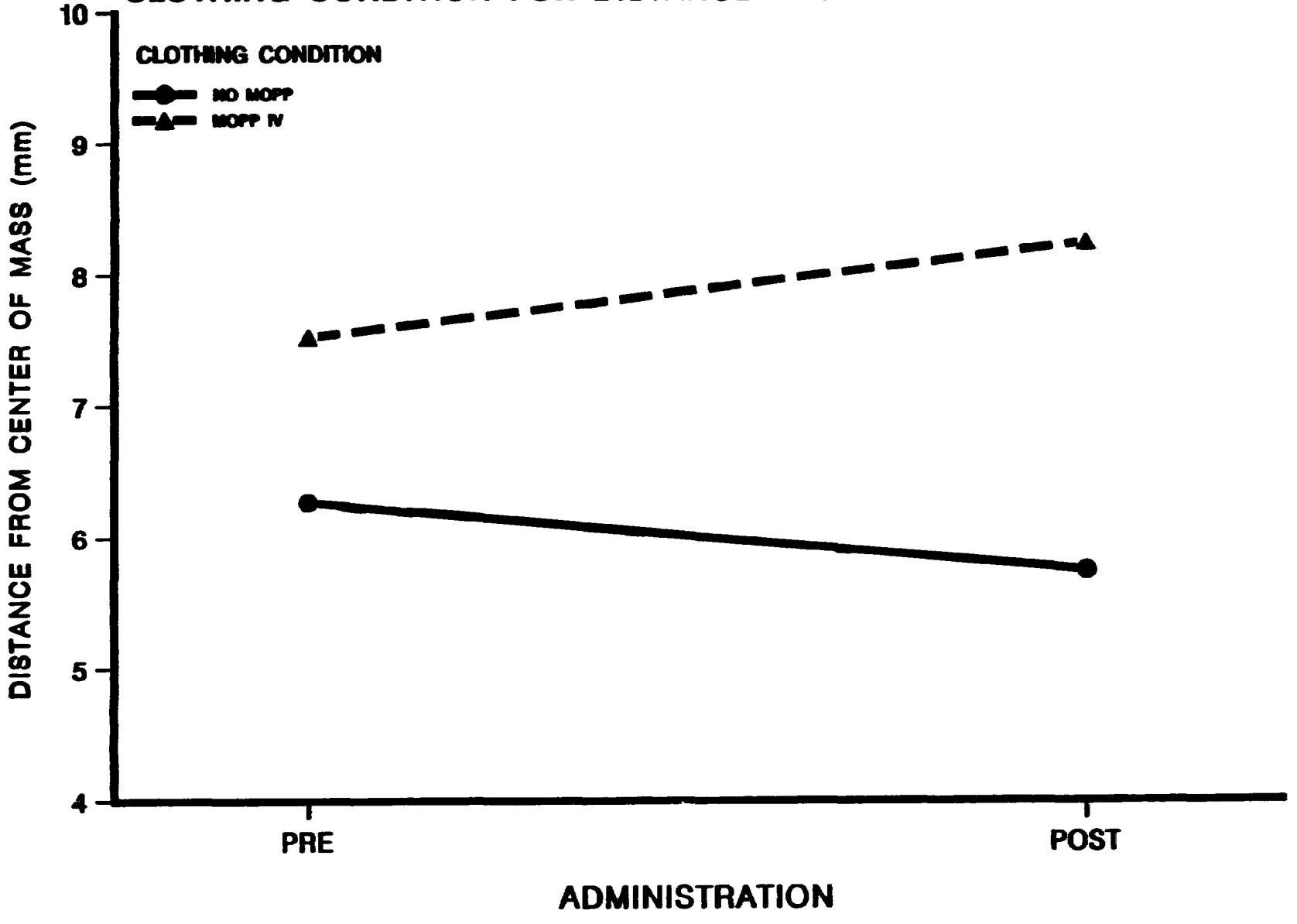
Subjects that lost the greatest amount of body weight, as well as those that did not fully rehydrate, shot poorer. Shots were further from the center of mass and displayed a greater dispersion. The effect of the physical stress of heat/exercise in MOPP IV along with its resultant dehydration is most evident when the soldier is required to shoot in MOPP IV. These findings are consistent with those of Johnson (5) and Johnson and Strowman (6) who found decrements in cognitive and psychomotor tasks due to water loss associated with inadequate rehydration during exercise in the heat. Rifle marksmanship consists of cognitive as well as fine motor control components.

Conclusions

The results demonstrate that exercising in the heat in MOPP IV negatively affects marksmanship. Individuals with a high %BWL/hr as well as those who do not rehydrate well are more susceptible to these performance decrements.

FIGURE 1

INTERACTION EFFECTS BETWEEN ADMINISTRATION AND CLOTHING CONDITION FOR DISTANCE FROM CENTER OF MASS



References

1. Armstrong, L.E. (1988). The impact of hyperthermia and hypohydration on circulation, strength, endurance, and health. Journal of Applied Sport Science Research, 2: 60-65.

2. Fine, B.J. and J.L. Kobrick (1985). Assessments of the effects of heat and NBC clothing on performance of critical military tasks. USARIEM, Natick, MA 01760, Technical Report NO T11-85.

3. Hubbard, R.W., M. Mager, and M. Kerstein (1982). Water as a tactical weapon: a doctrine for preventing heat casualties. Published in: Army Science Conference Proceedings 15-18 June 1982, Vol. 2, U.S. Military Academy, West Point, New York.

4. Johnson, R.F. (1981). The effects of elevated ambient temperature and humidity on mental and psychomotor performance. Published in: Handbook of the Thirteenth Commonwealth Defence Conference on Operational Clothing and Combat Equipment. Kuala Lumpur, Malaysia: Government of Malaysia.

5. Johnson, R.F. and J.L. Kobrick (1988). Ambient heat and nerve agent antidotes: effects on soldier performance with the USARIEM Performance Inventory. Published in: Proceedings of Human Factors Society (pp. 563-567) Santa Monica CA: Human Factors Society.

6. Johnson, R.F. and S.R. Strowman (1987). Effects of cooling and flavoring drinking water on psychological performance in a hot environment. Published in Proceedings of Human Factors Society (pp. 825-829). Santa Monica, CA: Human Factors Society.

7. Kobrick, J.L., R.F. Johnson, and D.J. McMenemy (1988). Nerve agent antidotes and heat exposure: Summary of effects on task performance of soldiers wearing BDU and MOPP IV clothing systems. USARIEM, Natick MA 01760, Technical Report NO T1/89.

8. Tharion, W.J., T.M. Rauch, I. Munro, and A.R. Lussier, L.E. Banderet, and B. Shukitt (1986). Psychological factors which limit the endurance capabilities of armor crews operating in a simulated NBC environment. USARIEM Natick, MA 01760, Technical Report NO T14/86.

9. Wyndham, C.H., and N.B. Strydom (1969). The danger of an inadequate water intake during marathon running. South African Medical Journal. 43: 893-896.